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John C. Galt  
John C. Galt

**AD 865520**

# **JILA INFORMATION CENTER REPORT**

No. 10

## **BIBLIOGRAPHY OF LOW ENERGY ELECTRON COLLISION CROSS SECTION DATA (1967-1969)**

by

**G. E. Chamberlain**

**L. J. Kleffer**

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February 16, 1970

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CONTENTS

	Page
I. INTRODUCTION-----	v
II. ERRATA	
Errata to NBS Misc. Pub. 289-----	ix
Published Errata to Cross Section Citations-----	xi
III. BIBLIOGRAPHY: ELECTRON PAPERS	
Elastic Scattering Experimental-----	3
Elastic Scattering Theoretical-----	3
Electronic Excitation Experimental-----	4
Electronic Excitation Theoretical-----	4
Electron Detachment Experimental-----	6
Electron Detachment Theoretical-----	6
De-Excitation Experimental-----	6
De-Excitation Theoretical-----	6
Ionization Experimental-----	6
Ionization Theoretical-----	7
Dissociation Experimental-----	8
Dissociation Theoretical-----	8
Free-Free Emission Theoretical-----	8
Dissociative Ionization Experimental-----	8
Dissociative Ionization Theoretical-----	8
Radiative Capture Experimental-----	8
Rotational Excitation Experimental-----	8
Rotational Excitation Theoretical-----	8
Vibrational Excitation Experimental-----	8
Vibrational Excitation Theoretical-----	9
Dissociative Attachment Experimental-----	9
Dissociative Attachment Theoretical-----	9
Total Scattering Experimental-----	9
IV. BIBLIOGRAPHIC REFERENCES-----	11
V. AUTHOR INDEX-----	37

## I. INTRODUCTION

This bibliography is a supplement to a previously issued bibliography,\* and includes all of the bibliographic material on electron collisions that has been added to our files since the previous publication. The literature for JILA Information Center Report No. 10 was searched from October, 1966, through October, 1969. Additional references from 1969 may not be included because of the delay time involved in adding items to our files and because we rely upon the abstracting journals to obtain references from sources which do not in general contain information of interest. The current scientific literature is searched on a continuing basis and items omitted herein will be included in future updatings of this bibliography.

The Electron Collision Cross Section Bibliography is divided into three main sections. The first section codes the data which are in the references included in the bibliography. The second section lists the title, authors and complete reference for the paper cited. These are ordered by their "file" number. The third section consists of an alphabetical author index. After each name is a list of the "file" numbers of articles authored or co-authored to be found in the bibliographic section.

### Description of the Coding Format

The data are categorized by a hierarchy of descriptors in the following order:

1. Process (e.g., elastic scattering, electronic excitation, etc.)
2. Experimental or Theoretical
3. Normalized or Relative (The data are considered normalized if given in absolute units.)
4. Atomic or Molecular Species including the degree of ionization of the species.

(A negative ion is indicated by a minus sign; neutral unexcited species by a blank; neutral excited species by a star; and a positive ion by a number indicating the degree of positive ionization. All of these symbols follow the atomic species, which are listed in ascending order of nuclear charge, Z. Molecular species are listed in arbitrary order.)

649 862

\* "Bibliography of Low Energy Electron Collision Cross Section Data," by L. J. Kieffer, NBS Miscellaneous Publication #289, 1967, available from the U.S. Government Printing Office, price 50 cents.

5. The references in which the data described are found. The references are identified by a file number, the first author, and the year of publication (e.g., 63 implies 1963).

The following comments about categories (see Contents) will aid in the proper use of the bibliography. The category Elastic Scattering replaces the previous categories Total Elastic and Differential Elastic Scattering. The following categories were deleted: Radiative<sup>+</sup> Attachment, Dissociative Recombination, and Radiative Recombination. The category Total Scattering covers cross sections which are the sum of elastic and inelastic cross sections. It includes any references to experimentally determined cross sections in which the experiment does not distinguish between elastically and inelastically scattered electrons even if the experiment is carried out in an energy range in which only elastic scattering is expected.

The abbreviations for journal titles are taken from Chemical Abstracts or if not abstracted there, from Science Abstracts, Series A Physics Abstracts.

#### Electron Collision Cross Section Bibliography

The criterion used in choosing the references for this bibliography is that the publication contain original measurements or calculations of electron cross sections. The target species covered were all the atoms plus simple molecules of atmospheric and astrophysical interest. The incident energy range covered was 0 to 10 KeV. The upper limit on the energy was not used as an absolute limit; however, one should not expect to find electron collision cross sections in the range of 50 KeV and above.

Papers containing the following quantities, which are not explicitly cross sections, have also been collected:

1. phase shifts,
2. scattering lengths,
3. ionization efficiencies,
4. excitation efficiencies.

The reason for including these quantities is that under the proper conditions, cross sections have been or can be simply derived from them.

Published manuscripts, theses, reports given at meetings, and company or agency reports which have been printed and circulated are included in the bibliography. However, reference is not made to material that is unavailable either through library facilities or government document centers. (No classified material is included.)

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<sup>†</sup> These processes are covered in part in JILA Information Center Report No. 4, A Bibliography of Electron Swarm Data 1967, by J. Dutton.

There is a tendency for authors to publish material which is identical to that which they have reported on at a meeting (which is printed and circulated) and also issued as a company or agency report. In some cases it is possible to verify that this is so and in those cases only one reference (the formal publication if there is one) is kept in our bibliography. In most cases it is not possible to make such a precise distinction among such documents, since only some of the material may have been available before. Because of this, there may be more than one reference to the same original data. We have tried to keep this to a minimum consistent with our aim of collecting all published data.

Inclusion of a reference in this bibliography does not imply a value judgment about the accuracy of the information. We only assert that this reference claims to report a measured or calculated electron collision cross section (or the equivalent as described previously). The question of the accuracy of the data is to be covered in separate published critical reviews [see, for example, Kieffer, L. J. and G. H. Dunn, Rev. Mod. Phys. 38, 1, (1966); Moiseiwitsch, B. L. and S. J. Smith, Rev. Mod. Phys. 40, 238 (1968)].

The authors would like to gratefully acknowledge the assistance of the staff of the JILA Information Center. The computer programs used for this report were written by Patricia Ruttenberg. The manuscript was prepared by Elizabeth Hosack and Victoria Tempey.

ERRATA TO NBS MISC. PUB. 289\*

The following should be deleted from the bibliography of electron processes:

Normalized	Total Elastic Scattering	Experimental
H	0933 Cody, 64	
Relative	Differential Elastic Scattering	Experimental
Hg	0486 Kessler, 65	
Normalized	Electronic Excitation	Theoretical
H	0585 Seaton, 62	
Relative	Dissociation	Experimental
H <sub>2</sub> O	0924 Mann, 40	
N H <sub>3</sub>	0924 Mann, 40	
Normalized		
O <sub>2</sub>	1460 Rapp, 65	
N O	1460 Rapp, 65	
N <sub>2</sub>	1460 Rapp, 65	
N <sub>2</sub> O	1460 Rapp, 65	
C O <sub>2</sub>	1460 Rapp, 65	
C O	1460 Rapp, 65	

The following should be added to the bibliography of electron processes:

Normalized	Differential Elastic Scattering	Experimental
Hg	0486 Kessler, 65	

The following should be added to the bibliography of positron processes:

Normalized	Total Elastic Scattering	Theoretical
H	0933 Cody, 64	

The following should be deleted from the citation and author lists:

585 Seaton, M. J. (The paper is correctly listed as 534.)

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\* National Bureau of Standards Miscellaneous Publication 289, 1967, U. S. Government Printing Office, price 50 cents.

PUBLISHED ERRATA TO ELECTRON COLLISION CROSS SECTION CITATIONS

<u>File</u>	<u>Citation</u>	<u>Erratum</u>
20	Hughes, A. L. and McMillen, J. H., Inelastic and elastic electron scattering in argon, <i>Phys Rev</i> <u>39</u> , 585-600 (1932).	<i>Phys Rev</i> <u>40</u> , 469-70 (1932).
256	DeVore, R. V., Absorption and Bremsstrahlung cross sections of nitrogen for slow electrons, <i>Phys Rev</i> <u>136</u> , A666-8 (1964).	<i>Phys Rev</i> <u>140</u> , AB3 (1965).
332	Stebbings, R. F. et al., Collisions of electrons with hydrogen atoms. V. Excitation of metastable 2S hydrogen atoms, <i>Phys Rev</i> <u>119</u> , 1939-45 (1960).	<i>Phys Rev</i> <u>124</u> , 2051-2 (1961).
503	Temkin, A., Electron-hydrogen phase shifts just below the inelastic threshold, <i>Phys Rev Lett</i> <u>10</u> , 22-5 (1963).	<i>Phys Rev Lett</i> <u>11</u> , 278-81 (1963).
773	Feldman, P. and Novick, R., Autoionizing states in the alkali atoms with microsecond lifetimes, <i>Phys Rev Lett</i> <u>11</u> , 278-81 (1963).	<i>Phys Rev</i> <u>168</u> , 270 (1968).
920	Doering, J. P. and Mahan, B. H., Photoionization of nitric oxide, <i>J Chem Phys</i> <u>36</u> , 669-74 (1962).	<i>J Chem Phys</i> <u>41</u> , 2724 (1963).
942	St. John, R. M. and Lin, C. C., Production of excitation and ionization in helium by single-electron impact, <i>J Chem Phys</i> <u>41</u> , 195-7 (1964).	<i>J Chem Phys</i> <u>47</u> , 347 (1967).
1082	Mjolsness, R. C. and Sampson, D. H., Distorted-wave calculation of rotational excitation of N <sub>2</sub> by slow electrons, <i>Phys Rev Lett</i> <u>13</u> , 812-15 (1964).	<i>Phys Rev Lett</i> <u>14</u> , 89 (1965).
1512	McGowan, J. W., et al., Electron-H-atom elastic-scattering resonances, <i>Phys Rev Lett</i> <u>15</u> , 917-20 (1965).	<i>Phys Rev Lett</i> <u>17</u> , 66 (1966).
1673	Mittleman, M. H., Single and double ionization of He by electrons, <i>Phys Rev Lett</i> <u>16</u> , 498-9 (1966).	<i>Phys Rev Lett</i> <u>16</u> , 779 (1966).
1695	Fox, M. A., Electron excitation from the ground state of helium to the 3 <sup>1</sup> D state, <i>Proc Phys Soc London</i> <u>88</u> , 65-9 (1966).	<i>Proc Phys Soc London</i> <u>90</u> , 585 (1967).
2626	Anderson, R. J. et al., Electron excitation functions of mercury, <i>Phys Rev</i> <u>157</u> , 31 (1957).	<i>Phys Rev</i> <u>185</u> , 404 (1969).

<u>File</u>	<u>Citation</u>	<u>Erratum</u>
2647	Kieffer, L. J. and Dunn, G. H., Dissociative ionization of H <sub>2</sub> and D <sub>2</sub> , Phys Rev <u>158</u> , 61-5 (1967).	Phys Rev <u>164</u> , 270 (1967).
2696	Lassettre, E. N. et al., Electron-impact spectrum of ethane, J Chem Phys <u>46</u> , 4536-7 (1967).	J Chem Phys <u>48</u> , 539 (1968).
2759	Feldman, P. and Novick, R., Auto-ionizing states on the alkali atoms with microsecond lifetimes, Phys Rev <u>160</u> , 143-58 (1967).	Phys Rev <u>168</u> , 270 (1968).
3729	Moustafa Moussa, H. R. et al., Excitation of helium by 0.05-6 KeV electrons and polarization of the resulting radiation, Physica <u>40</u> , 517-49 (1969).	Physica <u>42</u> , 490 (1969).
3774	Tai, H. et al., Angular distributions of elastically scattered electrons from hydrogen, Phys Rev Lett <u>22</u> , 1415 (1969).	Phys Rev Lett <u>23</u> , 453 (1969).

### III. BIBLIOGRAPHY

ELASTIC SCATTERING			EXPERIMENTAL		ELASTIC SCATTERING			THEORETICAL	
NORMALIZED					NORMALIZED				
HE	1209 VRIENS,68 1817 BROMBERG,69		3565 SCHEARER,68		C	2060 ROBINSON,67 3260 HENRY,68 3704 SMITH,69		2616 SMITH,67 3700 HENRY,69	
NA	1944 BALLING,66				N	2211 MJOLSNESS,67 2714 MALINOWSKA-ADAMSKA,68 3700 HENRY,69		2616 SMITH,67 3260 HENRY,68 3704 SMITH,69	
K	2822 RUMIN,59				O	3744 PEIXOTO,69			
CS	3202 NIGHAN,67				O	0588 HENRY,67 2016 BREIG,66 2071 GARRFITT,67 2616 SMITH,67 3700 HENRY,69		0878 GINGO,66 2060 ROBINSON,67 2211 MJOLSNESS,67 2714 MALINOWSKA-ADAMSKA,67 3704 SMITH,69	
HG	3811 EITEL,68				F	2060 ROBINSON,67			
N2	3817 BROMBERG,69				F	1 3825 MANSON,69			
CO	3817 BROMBERG,69				NE	1139 THOMPSON,66		3844 SHEOREY,69	
RELATIVE					NE	3826 ROBINSON,69			
H	3774 TAI,69				NE	1 3744 PEIXOTO,69		3825 MANSON,69	
HE	2290 MEHR,67 3513 SCHACKERT,68		2912 CHAMBERLAIN,67 3850 EIBSON,69		NA	2893 GARRETT,65			
NE	2290 MEHR,67		3513 SCHACKERT,68		NA	1 3744 PEIXOTO,69		3825 MANSON,69	
AR	2290 MEHR,67		3513 SCHACKERT,68		SI	2060 ROBINSON,67			
K	2947 COLLINS,67				SI	1 3825 MANSON,69			
KR	2290 MEHR,67		3513 SCHACKERT,68		S	2060 ROBINSON,67			
XE	2290 MEHR,67		3513 SCHACKERT,68		CL	2060 ROBINSON,67			
HG	2823 YEATES,67				AR	1139 THOMPSON,66 3882 MEISTER,68		3248 YATES,68 3844 SHEOREY,69	
BI	3578 HAUG,68				AR	1 3826 ROBINSON,69			
H2	3252 EHRHARDT,68		3377 EHRHARDT,68		AR	1 3825 MANSON,69			
N2	2179 EHRHARDT,67				K	1 3825 MANSON,69			
CO	3377 EHRHARDT,68				CA	1 3825 MANSON,69			
ELASTIC SCATTERING			THEORETICAL		SC	1 3825 MANSON,69			
NORMALIZED					NI	1 3825 MANSON,69			
H	3522 McDOWELL,68				ZN	1 3825 MANSON,69			
H	1169 KRAIDY,66 1976 ORMONDE,63 2126 JHA,66 2159 HOLY,68 2754 MICHELS,67 2959 CALLAWAY,68 3058 RARIK,67 3258 ARMSTEAD,68 3371 MADAN,68 3604 KELLY,68 3701 GARRETT,69 3738 MOHR,69 3774 TAI,69 3822 FRANCO,68		1906 GUPTA,67 2059 HOUSTON,68 2129 JHA,66 2749 JHA,67 2758 KELLY,67 2968 BANERJEE,67 3215 SLOAN,68 3370 RALL,68 3394 JHA,67 3511 SCHLESSINGER,68 3728 TRUHLAR,68 3762 ORMONDE,69 3881 MCDONALD,69		RA	1 3825 MANSON,69			
HE	1102 BANERJEE,66 2059 HOUSTON,68 2075 LAWSON,66 2127 BANERJEE,66 2751 BANERJEE,67 3340 HERZENBERG,68 3652 JHA,67 3586 HOUSTON,68 3686 MICHELS,69 3749 KHARE,69 3844 SHEOREY,69		2005 PU,66 2070 HASHIMO,66 2114 GUPTA,66 2714 MALINOWSKA-ADAMSKA,67 2959 CALLAWAY,68 3241 KENNEDY,68 3547 DOUGHTY,68 3603 PETERKOP,68 3705 POY,68 3772 LABAHN,69		GE	1 3825 MANSON,69			
HE	1364 HUSAIN,67 3826 ROBINSON,69		3516 SKLAREN,68		RR	2060 ROBINSON,67			
HE	1 3825 MANSON,69				KR	3248 YATES,68			
LI	2893 GARRETT,65 3348 FEAUTRIER,68		3057 MARRIOTT,67 3030 RURKE,69		KR	3826 ROBINSON,69			
LI	1 3522 McDOWELL,68		3825 MANSON,69		RE	1 3825 MANSON,69			
HE	1 3348 FEAUTRIER,68				CS	1178 BASU,66			
BE	3 3844 SHEOREY,69				EU	1 3825 MANSON,69			
BE	4 3844 SHEOREY,69				TA	1 3825 MANSON,69			
B	2177 SHODGRASS,68				AU	1 3825 MANSON,69			
					HE	3731 WALKER,69 3902 MEISTER,68		3773 YATES,69	
					HE	1 3825 MANSON,69			
					H2	8893 SHEPPARD,66 2466 MARA,67 3943 HENRY,69		1993 LANE,67 2777 WILKINS,67	
					H2	1 2027 YENKIN,67		3681 WEINBERG,68	

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ELASTIC SCATTERING		THEORETICAL	ELECTRONIC EXCITATION		EXPERIMENTAL
NORMALIZED			NORMALIZED		
			RELATIVE		
N2	8893 SHEPPARD,66		C 04	3432 VROOM,69	
H2O	2057 SHIMIZU,63				
N H3	2057 SHIMIZU,63				
CL2	8893 SHEPPARD,66				
H CL	3707 ITIKAWA,69				
C N	3707 ITIKAWA,69				
ELECTRONIC EXCITATION		EXPERIMENTAL	HE	1148 SIMPSON,66	2072 SOLTYSIK,67
NORMALIZED				2074 ZAPESOCHNYI,66	2175 DUGAN,67
H	2021 MILES,66	2962 KLEINPOPPEN,66		2176 DONELL,66	2341 MCFARLAND,67
3027 LONG,66	3373 WILLIAMS,66			2642 MEDOLE,67	2648 MEDOLE,67
3836 MCCONAHAN,66				2650 EHRHARDT,67	2911 GAVALLAS,67
HE	2690 HEAVYR,67	2757 SHPENIK,67		2912 CHAMBERLAIN,67	2915 DOERING,67
2838 JOBE,67	2841 VRIENS,66			2962 PICHANICK,66	3391 ANDRICK,68
2903 JOBE,67	2916 LUCAS,63			3410 EHRHARDT,66	3768 WHITTEKEP,67
2929 MOUSTAFA MOUSSA,67	3583 JOBE,66			3487 IONIKH,69	3813 KUPPERMANN,68
3598 ZAPESOCHNYI,67	3607 BARTS,66				
3724 MOUSTAFA MOUSSA,66	3714 LASSETTRE,69				
3838 BRONGERSMA,66	3666 ANDERSON,69				
LI	2726 ALEKSAKHIN,67	2759 FELDMAN,67	HE	1 2422 DALY,67	3323 REDHEAD,68
3063 ALEKSAKHIN,67					
HE	2725 FELTSAN,66	2989 ZAPESOCHNYI,67	LI	1990 ALEKSAKHIN,66	
3322 GUN,67				N	2074 ZAPESOCHNYI,66
HE	3457 KHAIKIN,66		HE	2176 DONELL,66	2911 GAVALLAS,67
HA	2030 ZAPESOCHNYI,67	2971 FRISH,67		2962 PICHANICK,66	
AR	2033 FELTSAN,67	3767 HERCER,67	AR	2176 DONELL,66	2911 GAVALLAS,67
K	2669 ZAPESOCHNYI,66	2715 KORCHEVCI,67	K	2874 ZAPESOCHNYI,66	2757 SHPENIK,67
2759 FELDMAN,67	2830 ZAPESOCHNYI,67			3069 RUBIN,69	
3519 HERTEL,66	3776 HERTEL,66				
3776 HERTEL,69					
KR	2798 FELTSAN,67		CA	3512 KARSTENSEN,66	
RB	1969 ZAPESOCHNYI,66	2869 ZAPESOCHNYI,66	ZH	2874 ZAPESOCHNYI,66	2757 SHPENIK,67
2715 KORCHEVCI,67	2759 FELDMAN,67			2907 ZAPESOCHNYI,66	
2839 ZAPESOCHNYI,67	3776 HERTEL,66				
3777 HERTEL,66	3776 HERTEL,66				
CO	2967 FELTSAN,67		HE	2176 DONELL,66	2962 PICHANICK,66
HE	3000 FELTSAN,66			3516 HERTEL,66	
CS	2669 ZAPESOCHNYI,66	2715 KORCHEVCI,67			
2630 ZAPESOCHNYI,67	3777 HERTEL,66				
DA	1 2930 BACON,66		HE	1968 BOGDANOVA,66	2074 ZAPESOCHNYI,66
HE	0877 ANDERSON,66	2676 ANDERSON,67		2620 BOGDANOVA,67	2023 YEATES,67
2643 FRISH,67	2757 SHPENIK,67			3418 ZAPESOCHNYI,66	3520 ZAPESOCHNYI,66
2923 TOWLED,67	3660 BODST,66			1989 SKERDELE,66	
H2	3813 KUPPERMANN,66	3871 VROOM,69	HE	1869 CAVILL,67	2939 DONELL,67
O2	3760 MCCONAHAN,66			3849 TRAJMAR,66	
H2	1969 ZAPESOCHNYI,66	2120 JOBE,67	O2	2176 KOVAL,66	3743 HASTED,69
2976 MOLLAND,66	3866 SKUDERICH,67			2176 KOVAL,66	2179 EHRHARDT,67
3667 GARTS,66	3710 STANTON,69			2659 SKERDELE,67	2827 LASSETTRE,62
3763 HASTED,66	3769 3818 STAVAYA,69			2915 DOERING,67	3762 BURNS,69
3838 BRONGERSMA,66	3832 TROXIE,66			3813 KUPPERMANN,66	3824 RIDGE,69
H2	1 3330 LEE,66		HE	3023 MILLER,69	
H2O	3012 VROOM,69				
C OF	3630 BRONGERSMA,66		N C	3763 HASTED,69	
C O	3066 SKUDERICH,67	3376 SKUDERICH,67	C 02	2172 DOERING,67	2915 DOERING,67
3030 BRONGERSMA,66				3813 KUPPERMANN,66	
C H6	3832 VROOM,66				
O2	3871 VROOM,66		C O	2604 SKERDELE,67	3209 FREUND,67
C2H6	3830 BRONGERSMA,66	3832 VROOM,66		3763 HASTED,69	3813 KUPPERMANN,66
C2H6	3832 VROOM,66			3836 DENPT,69	
ELECTRONIC EXCITATION			C 04	2918 EHRHARDT,67	3610 BRONGERSMA,66
NORMALIZED			O2	2939 DONELL,67	
			C 2H6	2606 LASSETTRE,67	3810 BRONGERSMA,66
			H	1113 COLTHAM,66	1171 CROTHAM,67
				1969 BURKE,66	2013 STAUFFER,66
				2022 MORRISON,66	2067 SMIDGEAN,66
				2077 GUNZBURG,67	2126 JONES,66
				2159 HOLT,66	2733 CROTHAM,67
				2736 CROTHAM,67	2769 JONES,67
				2791 BURKE,67	2792 TAYLOR,67
				3054 MCCONAHAN,67	3055 BURKE,67
				3056 RABIE,67	3065 VAJNHEZER,67

ELECTRONIC EXCITATION		THEORETICAL	ELECTRONIC EXCITATION		THEORETICAL
NORMALIZED			NORMALIZED		
H	3388 HARRIOTT,68	3572 PERESSE,68	MG	6 2020 SARAPH,68	
	3580 GAUDIN,68	3642 KOLODZIEJSKI,68	AL	5 3294 CZYZAK,67	
	3728 TRUHLAR,68	7782 ORMONDE,69	P	1 1992 BELY,67	3294 CZYZAK,67
	3775 KYLE,68	3805 OCHKUR,68		5 2335 CZYZAK,67	
	3839 KYLE,69			2 1992 BELY,67	3294 CZYZAK,67
H *	1946 PLUTA,66	2063 PURCELL,52		5 10 2020 SARAPH,68	
	2786 MONINN,67	3714 VAN BLERKOM,68		CL 1 3294 CZYZAK,67	
HE	1941 JOACHAIN,66	2017 VRIENS,67		CL 2 2335 CZYZAK,67	
	2655 INOKUTI,67	2685 MORRISON,67		CL 3 1992 BELY,67	3294 CZYZAK,67
	2733 BEIGHAN,67	2790 RAHERJEF,67		AR 1 1978 VELDRE,68	
	2837 INOKUTI,67	3002 KENNEDY,68		AR 2 3294 CZYZAK,67	
	3010 BELL,68	3019 BELL,68		AR 3 2335 CZYZAK,67	
	3059 LYASH,67	3206 MILLER,68		AR 4 1992 BELY,67	3294 CZYZAK,67
	3208 BELL,68	3211 LIN,68		AR 10 3294 CZYZAK,67	
	3255 KANG,68	3341 KENNEDY,68		AR 11 3294 CZYZAK,67	
	3304 CARTWRIGHT,68	3521 KIM,68		AR 12 1992 BELY,67	
	3579 LYASH,67	3587 BELL,68		K 3709 MATHUR,68	
	3698 VAINSHTEIN,69	3770 VAN DEN BOS,69		K 3 3294 CZYZAK,67	
	3733 BELL,69			K 4 2335 CZYZAK,67	
HE *	2013 STAUFFER,66	3056 BURKE,67		K 5 3294 CZYZAK,67	
	3847 KIM,69			K 13 1992 BELY,67	
HE 1	2427 ORMONDE,67	7761 KYLE,67		CA 3060 BEIGHAN,67	
	3734 BURKE,69			CA 1 1138 BELY,68	3818 BURKE,68
LI	3057 HARRIOTT,67	3789 MATHUR,68		CA 4 3294 CZYZAK,67	
	3088 BURKE,69			CA 5 2335 CZYZAK,67	
LI 1	2733 BEIGHAN,67	3579 LYASH,67		CA 6 3294 CZYZAK,67	
BE 1	2118 BELY,66			CA 7 3294 CZYZAK,67	
BE 2	1979 LYASH,67			V 0 2335 CZYZAK,67	
BE 3	1979 LYASH,67			V 0 3294 CZYZAK,67	3294 CZYZAK,67
C	2616 SMITH,67	3700 HENRY,69		V 1 1992 BELY,67	
	3704 SMITH,69			CR 1 1992 BELY,67	
C 2	2733 BEIGHAN,67	3579 LYASH,67		CR 10 3294 CZYZAK,67	
C 4	2733 BEIGHAN,67	2616 SMITH,67		CR 11 1992 BELY,67	
H	1978 VELDRE,68	3704 SMITH,69		CR 12 3294 CZYZAK,67	
	3788 HENRY,69			CR 13 2020 SARAPH,68	
H 1	1992 BELY,67	2070 SARAPH,66		CR 14 1992 BELY,67	
	3788 HENRY,69			CR 15 3294 CZYZAK,67	
H 4	2118 BELY,66			CR 16 1992 BELY,67	
H 5	3579 LYASH,67			FE 0 2335 CZYZAK,67	
O	1978 VELDRE,68	2013 STAUFFER,66		FE 0 3294 CZYZAK,67	
	2616 SMITH,67	2024 BREIG,66		FE 1 1992 BELY,67	3294 CZYZAK,67
	3700 HENRY,69	3704 SMITH,69		FE 10 3294 CZYZAK,67	
O 1	3294 CZYZAK,67	7700 HENRY,69		FE 11 1992 BELY,67	
	3739 MARTINS,69			FE 12 3294 CZYZAK,67	
O 2	1992 BELY,67	3869 MIYANOTO,68		FE 13 2020 SARAPH,68	
	3788 HENRY,69	3732 KISSNER,69		FE 14 3294 CZYZAK,67	
O 4	3060 BEIGHAN,67			FE 15 2832 PETRINCI,67	
O 6	3579 LYASH,67			FE 16 3013 BELY,67	
F 1	3294 CZYZAK,67			FE 17 3294 CZYZAK,67	
F 2	3294 CZYZAK,67	3739 MARTINS,69		FE 18 1992 BELY,67	2118 BELY,66
HE	1978 VELDRE,69			FE 19 2832 PETRINCI,67	
HE 2	3294 CZYZAK,67			FE 20 3013 BELY,67	
HE 3	3294 CZYZAK,67	3739 MARTINS,69		FE 21 3294 CZYZAK,67	
HE 4	2020 SARAPH,66			FE 22 1992 BELY,67	
HE 7	2118 BELY,66			FE 23 3294 CZYZAK,67	
HE 11	1199 POSENIAKOV,68	2069 POSENIAKOV,68		FE 24 3294 CZYZAK,67	
	3064 VAINSHTEIN,67	3700 MATHUR,68		FE 25 2020 SARAPH,68	
HE 9	3294 CZYZAK,67			FE 26 2870 VELDRE,68	
HE 6	3294 CZYZAK,67	7730 MARTINS,69		FE 27 3000 MATHUR,68	
HE 8	1992 BELY,67			FE 28 3037 TREPATWI,68	
HE 1	3018 BURKE,68			FE 29 1978 VELDRE,68	
HE 4	3294 CZYZAK,67			FE 30 3000 MATHUR,68	
HE 9	3294 CZYZAK,67			FE 31 2760 LHN,68	3818 MCCONNELL,68

ELECTRONIC EXCITATION		THEORETICAL	IONIZATION		EXPERIMENTAL
NORMALIZED			NORMALIZED		
HG	3616 YAVORSKY,62	3637 TRIPATHI,69	NE	8569 GLUPE,67	2744 GAUDIN,67
H2	2024 KHARE,66 2627 KHARE,67 2913 MILLER,67 3344 CARTWRIGHT,68 3603 PROK,69	2066 KHARE,66 2773 CARTWRIGHT,67 2914 ROZSNYAI,67 3545 TRAJMAR,68	NA	3569 PERESSE,65 3619 ZAPESOCHNYI,69	3819 VAN DER WIEL,69
H2	1 2914 ROZSNYAI,67	3842 PEER,69	NA	1 2977 PEART,68	
O2	3574 TAKAYANAGI,67		HG	1 3608 MARTIN,68	
O2	1 2820 SARAPH,66		AR	6623 BENNETT,66 2123 HANNER,67 2049 MELTON,67 3643 DOLGOV-SAVELEV,68 3819 VAN DER WIEL,69	2120 SRINIVASAN,67 2744 GAUDIN,67 3569 PERESSE,65 3767 MERCER,67
H2O	2914 ROZSNYAI,67		K	2715 KORCHEVOI,67	3699 ZAPESOCHNYI,69
	3623 MILLER,69		CA	2713 MCFARLAND,67	
ELECTRON DETACHMENT		EXPERIMENTAL	CU	2729 PAVLOV,67	2917 CRAWFORD,67
NORMALIZED			KR	3851 SRINIVASAN,67	3569 PERESSE,65
H	2788 DANCE,67	2904 TISONE,68	RB	1969 ZAPESOCHNYI,66 3699 ZAPESOCHNYI,69	2715 KORCHEVOI,67
O	2904 TISONE,68		SR	2713 MCFARLAND,67	
ELECTRON DETACHMENT		THEORETICAL	AG	2729 PAVLOV,67 2917 CRAWFORD,67	2825 CRAWFORD,66 2918 CRAWFORD,67
NORMALIZED			IE	3569 PERESSE,65	
H	2116 ROGALSKI,68	3428 INOKUTI,68	CS	2715 KORCHEVOI,67 3699 ZAPESOCHNYI,69	3655 NYGAARD,68
DE-EXCITATION		EXPERIMENTAL	DA	2713 MCFARLAND,67	
NORMALIZED			RA	1 3256 PEART,68	
HE	2698 KHAIKIN,68		TL	2713 MCFARLAND,67	
RELATIVE			PO	2729 PAVLOV,67	3643 WANG,69
HG	2646 BURTON,67	3871 BURTON,68	H2	2956 MCCONKEY,68	
H2	3543 BURTON,68		O2	3026 NISHIMURA,68 3347 KOROL,68 3578 SKUBENICH,68	3664 SKUBENICH,67 3927 PERESSE,67 3768 MCCONKEY,68
DE-EXCITATION		THEORETICAL	H2	1214 MCCONKEY,67 1963 NAYAKANA,68 2923 FOWLER,67 3026 NISHIMURA,68 3066 SKUBENICH,67 3527 PERESSE,67 3769 SKUBENICH,68	1001 DALY,66 2785 HOLLAND,67 2964 SRIVASTAVA,68 3051 SRINIVASAN,67 3524 SRIVASTAVA,68 3710 STANTON,69
NORMALIZED			H2O	3212 COMET,67	
H	2063 PUNCELL,62		C2H2	2766 GAUDIN,67	
IONIZATION		EXPERIMENTAL	C O2	3826 NISHIMURA,68 3927 PERESSE,67	3266 MCCONKEY,68
NORMALIZED			C O	2120 SRINIVASAN,67 3176 SKUBENICH,67	3664 SKUBENICH,67
H	2786 MCCONKEY,68	2956 MCCONKEY,68	C H2	2399 MELTON,67	3527 PERESSE,67
HE	1942 ANDERTON,67 2766 GAUDIN,67 3569 PUNCELL,68	2690 HEAVY,67 3841 HOUSTON & HOUSSE,67 3619 VAN DER WIEL,69	HE	3531 KRISTE,68 3839 MARCHAND,69	3767 ENNAROT,69
H2	3509 LIND,67		H2	1 1001 DALY,66	
L2	3063 ALEXANDRIN,67	3699 ZAPESOCHNYI,69	HG	2969 FIGUET-FAYARD,68	
L2	1 2771 HARRING,67	3296 PEART,68	AR	0958 HAGSTROM,66 3039 MARCHAND,69	2369 SCHWAN,68
C	0959 GLUPE,67		CA	2668 KUPRIYANOV,68	
H	0960 GLUPE,67		PN	2760 ZIESEL,67	2969 FIGUET-FAYARD,68
O	0960 GLUPE,67		CE	2964 LIN,67	
NORMALIZED			ER	0958 HAGSTROM,66 2762 ZIESEL,67	2369 SCHWAN,68 2767 HEMMORN,68
			ER	1 3766 LATYPOV,68	
			RR	2366 SHINOH,64 2969 FIGUET-FAYARD,68	2762 ZIESEL,67

IONIZATION		EXPERIMENTAL		IONIZATION		THEORETICAL	
RELATIVE				NORMALIZED			
SR	2668 KUPRIYANOV,66	2762 ZIESEL,67		NE	2976 KOOZEKANANI,67	3269 KOOZEKANANI,68	
SN	2944 LIN,67				3456 KOOZEKANANI,68	3581 GAUDIN,68	
XE	8550 HAGSTRUM,66				3585 PEACH,68		
CS	1 3050 EMELYANOV,67			NE	1 3750 THOMAS,69		
BA	2761 ZIESEL,67			NA	1163 BATES,69	2905 GARCIA,67	
MG	3520 ZAPESOCHNYI,64				3582 GAUDIN,68	3735 TRIPATHI,69	
PB	2944 LIN,67				2713 MCFARLAND,67	3582 GAUDIN,68	
RI	2900 KOHL,67				3037 TRIPATHI,69		
O2	1888 PERESSE,65	2174 KOVAL,66		MG	1 3883 BELY,68		
	2388 TURNER,67	2070 PERESSE,67		AL	3582 GAUDIN,68	3585 PEACH,68	
N2	1888 PERESSE,65	2174 KOVAL,66		AL	2 3883 BELY,68		
	2614 KIEFFER,67	2969 FIQUET-FAYARD,68		SI	3582 GAUDIN,68	3585 PEACH,68	
N2	1 1881 DALY,66			P	3582 GAUDIN,68	3585 PEACH,68	
N H3	2969 FIQUET-FAYARD,68				4 3883 BELY,68		
N O	2969 FIQUET-FAYARD,68			S	3582 GAUDIN,68	3585 PEACH,68	
C2H2	3888 ARION,69			CL	3582 GAUDIN,68	3585 PEACH,68	
C O2	1888 PERESSE,65	2119 SJOGREN,66		AR	2976 KOOZEKANANI,66	2648 VAINSHTEIN,67	
C O	2969 FIQUET-FAYARD,68				2799 VAINSHTEIN,67	3456 KOOZEKANANI,68	
C H4	2518 EHRENDORF,67	2658 BREHM,67			3582 GAUDIN,68	3585 PEACH,68	
H2S	2969 FIQUET-FAYARD,68			K	2713 MCFARLAND,67	2905 GARCIA,67	
C S2	2969 FIQUET-FAYARD,68				3735 TRIPATHI,69	3004 TRIPATHI,69	
C O S	2969 FIQUET-FAYARD,68			CA	2713 MCFARLAND,67	3037 TRIPATHI,69	
O1Z	2900 KOHL,67				9 3883 BELY,68		
				FE	15 3883 BELY,68		
				NI	2695 PERLMAN,68	2901 KOLBENSTVEDT,67	
				ZH	3037 TRIPATHI,69		
				KR	2976 KOOZEKANANI,67	3269 KOOZEKANANI,68	
				RB	2713 MCFARLAND,67	2905 GARCIA,67	
					3735 TRIPATHI,69		
				SR	2713 MCFARLAND,67		
				AE	2901 KOLBENSTVEDT,67		
				CD	3037 TRIPATHI,69		
				SN	2901 KOLBENSTVEDT,67		
				CS	2713 MCFARLAND,67	2905 GARCIA,67	
					3735 TRIPATHI,69		
				RA	2713 MCFARLAND,67		
				AU	2901 KOLBENSTVEDT,67		
				MG	2695 PERLMAN,68	3462 OMIDVAR,67	
					3037 TRIPATHI,69		
				TL	2713 MCFARLAND,67		
				W2	3883 PROK,69		
				O2	3576 TAKAYANAGI,67		
					W2	3883 PROK,69	
				RELATIVE			
				ME	1 3828 KOOZEKANANI,68		
				AR	1 3828 KOOZEKANANI,68		
				ER	1 3828 KOOZEKANANI,68		

DISSOCIATION		EXPERIMENTAL	DISSOCIATIVE IONIZATION		EXPERIMENTAL
NORMALIZED					RELATIVE
H2	2945 DE HEER,67	3831 VR0OM,69	C H4	2658 BREHM,67	
H2	1 2171 DUNN,67	2798 DANCE,67	O2	2647 KIEFFER,67	3023 FIQUET-FAVARD,68
O2	2762 SPOKA,67		S F6	2215 OIBELER,68	
O2	1 2772 VAN ZYL,67		C H3CL	2731 GUTBIER,56	
H2	3033 SPOKA,69		C H3RR	2731 GUTBIER,56	
H2	1 2772 VAN ZYL,67		C F4	2215 OIBELER,68	
H2O	3812 VR0OM,69		S1 F4	2215 OIBELER,68	
C O2	3759 CORVIN,69		H2O R2	2731 GUTBIER,56	
C H4	2899 MELTON,67	3832 VR0OM,69	H2CL2	2731 GUTBIER,56	
O2	3831 VR0OM,69		P12	2908 KOHL,67	
O2	1 2171 DUNN,67				
C2H4	3832 VR0OM,69				DISSOCIATIVE IONIZATION THEORETICAL
C2H6	3832 VR0OM,69				
C O4	3832 VR0OM,69		RELATIVE		
RELATIVE					H2 1968 MCCULLOM,68
H2	3801 LEVENTHAL,67	3756 CLAMPITT,69			
H2	2737 NIEMIUS,67				RADIATIVE CAPTURE EXPERIMENTAL
H2	2 1881 DALY,66				
H2O	3205 FREUND,67	3756 CLAMPITT,69			
C O2	3205 FREUND,67		NORMALIZED		
					CS 1 2008 AGNEW,68
DISSOCIATION		THEORETICAL	ROTATIONAL EXCITATION		EXPERIMENTAL
NORMALIZED					NORMALIZED
H2	3344 CARTWRIGHT,68		H2	3252 EHRENDORF,68	
H2	1 2210 PEPE,67				
	2966 OIKSTUK,67	2691 ZARE,67			
		2642 PEPE,69			
FREE-FREE EMISSION		THEORETICAL	ROTATIONAL EXCITATION		THEORETICAL
NORMALIZED					NORMALIZED
H	2211 HJOLSTHEIM,67		H2	1993 LANE,67	2626 SAMPSON,63
O	2211 HJOLSTHEIM,67			3025 ARDILL,68	3349 LANE,68
				3006 ADRIAN,69	3028 CHANG,69
				3063 HENRY,69	
			H2	2626 SAMPSON,63	
			H CL	3707 ITIKAWA,69	
DISSOCIATIVE IONIZATION		EXPERIMENTAL	C H	3706 TAKAYANICI,68	3707 ITIKAWA,69
NORMALIZED					
O2	2762 VR0OM,67	3827 PEPE,67			VIBRATIONAL EXCITATION EXPERIMENTAL
H2	1881 DALY,66	3827 PEPE,67			
	3031 VR0OM,69				
C2H2	2766 SANOZAKI,67				
C O2	3527 PEPE,67		H2	3327 EHRENDORF,68	
C H4	2899 MELTON,67	3827 PEPE,67	C O2	3709 BONEST,68	
RELATIVE			C O	3327 EHRENDORF,68	
H2	2667 KIEFFER,67				
O2	2300 TURNER,67				
H2	2616 KIEFFER,67				
C O2	2120 SJOGREN,68		H2	1977 HENKINS,66	
			O2	3946 SCHROEDER,68	
			H2	3363 WALL,68	3046 SCHROEDER,68
			O2	3947 SCHROEDER,68	

VIBRATIONAL EXCITATION		EXPERIMENTAL	DISSOCIATIVE ATTACHMENT		EXPERIMENTAL
RELATIVE			RELATIVE		
N 0	3546 SKERBELE,68		LI CL	2910 ERINGHAUS,64	
C 02	3547 SKERBELE,68	3770 ANDRICK,69	SI CL4	2786 VOUGHT,67	3641 JAGER,68
C 0	3546 SKERBELE,68		H29E	2730 KNUERT,53	
VIBRATIONAL EXCITATION		THEORETICAL	TL CL	3416 KHOVSTENKO,64	
NORMALIZED			TL BR	3416 KHOVSTENKO,65	
H2	2884 BARDSLEY,66	2790 TAKAYANAGI,65	IN AR	3617 KHOVSTENKO,64	
	2824 BREIG,66	3886 ARRHAN,69	DISSOCIATIVE ATTACHMENT		
H2	3684 BOIKOVA,68		THEORETICAL		
H2	2824 BREIG,66		NORMALIZED		
N 0	2760 LIN,64		H2	2884 BARDSLEY,66	
C 0	2760 LIN,64	2824 BREIG,66	TOTAL SCATTERING		
ME H	1 3684 BOIKOVA,68		EXPERIMENTAL		
DISSOCIATIVE ATTACHMENT		EXPERIMENTAL	NORMALIZED		
NORMALIZED			ME	2327 RAMSAUER,71	2328 NY,77
H2	2763 SCHULZ,67			2633 CROWPTON,67	2648 BALDWIN,67
O2	3841 HENDERSON,69			2906 POLUSHKIN,66	2956 POLUSHKIN,66
N2O	2888 BAILEY,70			2957 CAVALLAS,67	3204 TICE,67
N H3	2888 BAILEY,70	3287 SHARP,68		3560 VOLKOV,68	3782 HOFFMANN,69
N2O	3845 CHAMPT,69		H	2793 HOFFMANN,67	
H CL	2888 BAILEY,70	3287 CHRISTOPHOROU,68	O	1949 DAIBER,66	2170 SUNSHINE,67
C H4	2285 SHARP,67	2890 MELTON,67	ME	2326 RAMSAUER,71	2326 NY,77
C CL4	3086 CHRISTOPHOROU,68			2957 CAVALLAS,67	3560 VOLKOV,68
N 0	2763 SCHULZ,67			3782 HOFFMANN,69	
O2	2763 SCHULZ,67		AR	1969 DAIBER,66	2327 RAMSAUER,71
H I	3087 CHRISTOPHOROU,68			2328 NY,77	2648 BALDWIN,67
H BR	3087 CHRISTOPHOROU,68			2906 POLUSHKIN,66	2956 POLUSHKIN,66
C D4	2285 SHARP,67			2957 CAVALLAS,67	3204 TICE,67
N D3	3287 SHARP,68	3763 COMPTON,69		3560 VOLKOV,68	
C CL3P	3086 CHRISTOPHOROU,68		ME	2326 RAMSAUER,71	3560 VOLKOV,68
CL2P2	3086 CHRISTOPHOROU,68			3782 HOFFMANN,69	
O CL	3087 CHRISTOPHOROU,68		IE	2326 RAMSAUER,71	3560 VOLKOV,68
O BR	3087 CHRISTOPHOROU,68			3782 HOFFMANN,69	
O I	3087 CHRISTOPHOROU,68		CS	2906 POLUSHKIN,66	
RELATIVE				ME	2727 RAMSAUER,71
H2	2977 DOWELL,68			02	2870 CHANTAY,66
N H3	2975 ERNAUS,61				2170 SUNSHINE,67
N 0	3292 CHANTAY,68			H2	1997 GOLDEN,66
C O2	2975 ERNAUS,61				2326 RAMSAUER,71
C O	3292 CHANTAY,68	3036 BENNET,69		H2O	2888 BAILEY,70
NA CL	2910 ERINGHAUS,64				3203 TICE,67
H2I	2790 KNUERT,53	1979 ERNAUS,61		H H3	2888 BAILEY,70
C S2	1978 ERNAUS,61				3203 TICE,67
S P4	2746 BUCHELNITZKA,68			H2O	3203 TICE,67
S O2	2074 ERNAUS,61			C O2	2326 RAMSAUER,71
				C O	2326 RAMSAUER,71
				H CL	2888 BAILEY,70
				C H4	2326 RAMSAUER,71
				02	3203 TICE,67
				C P4	3203 TICE,67
				C S4	3203 TICE,67

POSITRON PAPERS

ELASTIC SCATTERING THEORETICAL

NORMALIZED

H	2812 BRANSDEN,66 2776 FELS,67 3092 DRACHMAN,67 3781 GARRETT,69	2859 HOUSTON,68 2959 CALLAWAY,68 3358 DRACHMAN,68 3848 RAMNAN,69
HE	2859 HOUSTON,68 3092 DRACHMAN,67	2959 CALLAWAY,68 3053 KRAJCIK,67

ELECTRONIC EXCITATION THEORETICAL

NORMALIZED

H 2937 DANSBURG,68

IONIZATION THEORETICAL

NORMALIZED

HE 3827 FERRANTE,69

ROTATIONAL EXCITATION THEORETICAL

NORMALIZED

H2 2763 TAKAYAMAGI,67  
H2 2903 TAKAYAMAGI,67

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DISSOCIATIVE ATTACHMENT OF ELECTRONS TO HOT OXYGEN  
PHYS REV, VOL 183, 387-396, (1969)

3842 PEER J H, GREEN T A  
IMPROVEMENT IN THE FIRST ORDER THEORY OF ELECTRON SCATTERING BY MOLECULAR SYSTEMS. II. EXAMPLE OF THE 1/2 SIGMA CO<sub>2</sub> - P D SIGMA UNPERTURBED TRANSMISSION IN IMPULSE  
PHYS REV, VOL 183, 709-712, (1969)

3843 HENRY R J H, LANE N F  
POLARIZATION AND EXCHANGE EFFECTS IN LOW-ENERGY ELECTRON-H<sub>2</sub>  
SCATTERING  
PHYS REV, VOL 183, 221-231, (1969)

3844 SMEOREY V A  
PHASE SHIFTS FOR ELASTIC SCATTERING BY NEUTRAL ATOMS USING  
ISOELECTRONIC SEQUENCE EXTRAPOLATION TECHNIQUES  
J PHYS & ATOM MOL PHYS 2, VOL 2, 462-457, (1969)

3845 CHANEY E L, CHRISTOPHOROU L G  
ELECTRON ATTACHMENT TO N<sub>2</sub>O  
J CHEM PHYS, VOL 51, 883-892, (1969)

3846 ANDERSON R J, HUGHES R H,  
NORTON T G  
EXCITATION OF THE 3 SINGLET, TRIPLET D AND 4 SINGLET, TRIPLET  
F LEVELS OF HELIUM BY DIRECT ELECTRON IMPACT, AND 4 SINGLET  
P TO 4 SINGLET, TRIPLET F COLLISIONAL TRANSFER  
PHYS REV, VOL 181, 198-205, (1969)

3847 KIM Y K, INOKUTI M  
GENERALIZED OSCILLATOR STRENGTHS OF THE HELIUM ATOM.  
II. TRANSITIONS FROM THE METASTABLE STATES  
PHYS REV, VOL 181, 205-214, (1969)

3848 BORST W L  
PRODUCTION OF METASTABLE MERCURY ATOMS BY ELECTRON IMPACT  
PHYS REV, VOL 181, 257-263, (1969)

3849 RUBIN K, REDERSON R,  
GOLDSTEIN M, COLLINS P E  
ELECTRON-ALKALI-METAL INELASTIC RECOIL EXPERIMENTS WITH SPIN  
ANALYSIS - EXPERIMENTAL METHOD AND THE SMALL-ANGLE BEHAVIOR  
OF THE 4 DOUBLET S 1/2 TO 4 DOUBLET P 1/2,3/2 EXCITATION OF  
POTASSIUM  
PHYS REV, VOL 182, 201-214, (1969)

3850 GIBSON J R, DOLDEK K T  
DESONANT DIFFERENTIAL SCATTERING OF ELECTRONS BY HELIUM  
J PHYS & ATOM MOL PHYS 2, VOL 2, 741-746, (1969)

3851 MC CONKEY J M, SIMPSON F P  
ELECTRON IMPACT EXCITATION OF THE B TRIPLET PI GERADE STATE  
OF N<sub>2</sub>  
J PHYS & ATOM MOL PHYS 2, VOL 2, 923-929, (1969)

V. AUTHOR INDEX

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## AUTHOR INDEX

AMTS J F H	3607	AMMERS J P	3617
AMUAF R	2761	AMUSOVA N N	3618 3620
AMYAN R A	3606	AMYELIKHOVA N S	746
AMYNES R	2160	AMYRE P G	1979 2016 2701 2702 3665 2076 3610 3700 3730 3762 3630
AMYNE L	2000	AMYRE S J	1216 3206 3762
ALEKSANDR Z S	1990 2726 3043 3699	AMYRE P H	2646 3071 3643
ALLEGRAU R J	877 1942 2026 3646	AMYRE P J	1009
AMRICK A	3770	AMYRE P	2999 3516 3772
AMRICK G	3791	AMYRE H P	3230
AMYRE R H D	3623	AMYRE K S	2900
AMYSTEAD R L	3230	AMYRE D C	2772 3246 3646 3720
AMYRE R E K	2763	AMYRE C H	2036
AMYRE D G	2170	AMYRE C E	2912
AMYRE A H	3763	AMYRE C L	2645
AMYRE P H	2330	AMYRE C S	2605 3626
AMYRE V A	2000	AMYRE P J	2670 3212
AMYRE C C	2640	AMYRE J C V	3270
AMYRE L C	1940 3771	AMYRE S	2320
AMYRE J S	3370	AMYRE J	2647 3623
AMYRE S H	2100 2126 2127 2129 2750 2751 2964 3652	AMYRE C K	2693
AMYRE J H	2004	AMYRE A L	1364
AMYRE R H	3770	AMYRE L C	3606 3637 3645
AMYRE A H	1170	AMYRE R	3796
AMYRE D H	1163	AMYRE E H	2704 2934 2905
AMYRE J L	3626	AMYRE R C	2647 3649
AMYRE J D	2170 2967 3649	AMYRE B H J	2300
AMYRE T L	2720 2946 3600	AMYRE R H	3607 3762
AMYRE K L	3610 3619 3200 3507 3733	AMYRE H J	3704
AMYRE P	2115 3613	AMYRE J H	3696
AMYRE G	2130 1992 2115 2110 3603 3613 3736	AMYRE S J H	3799
AMYRE H R	613	AMYRE K K	3799
AMYRE R S	3621	AMYRE B H	3627
AMYRE A J H	2349	AMYRE J H	3691
AMYREVA I P	1900 2620	AMYRE C K	2627 2917 2920 3643
AMYREVA R F	3604	AMYRE R H	2433
AMYREVA A H	3696 3579	AMYRE B	1171 2736
AMYREVA H J H	2309	AMYRE E K	3636
AMYREVA T F H	2504	AMYRE S J	2339 3264
AMYREVA H L	3640	AMYRE J H	1945
AMYREVA R	3900 3601 3902	AMYRE H R	1661 2422
AMYREVA A H	1103	AMYRE R	2937
AMYREVA R T	3641	AMYRE B F	2700 2790
AMYREVA L H	2904	AMYRE B	3770
AMYREVA R H	2612	AMYREVITS P	3543
AMYREVA V F	2796	AMYREVA H B	3625
AMYREVA B	2650	AMYREVA F J	2369 2945 3761 3687 3729 3612 3631 3632
AMYREVA E L	2616 2826	AMYREVA A H	3322
AMYREVA R T	3545	AMYREVA V H	2215
AMYREVA C E	3600	AMYREVA H H	3607
AMYREVA R H	3643		

PRECEDING PAGE BLANK

DILLON M A	2659 2694 2696 3546 3547	GOLDEN D E	1997
	3814		
DOERING J P	2172 2915	GOLDSTEIN M	2947 3849
DODDER K T	2721 2977 3206 3400 3850	GOMEZ J C	3212
DOLGOV-SAVELEV G	3693	GORDON S M	3531
DOUGHTY M A	3567	GOROKHOV L N	3050
DOWELL J T	2176 2205 2577 2939 3287	GRAY R L	2872
DRACHMAN R J	3852 3350	GREEN Y A	3842
DUDKO D Y	2906 2956	GUK SIN S/M	3322
DUGAN J L G	2175	GUPTA S B	1904 2114
DUNCANSON M E	2888	GUTBIER H	2731
DUNN G H	2171 2667 2772	HAARHOFF P C	3531
DUXLER M H	2959	HAGEMANN R	2744
EBINGHAUS H	2910	HAGSTRUM H D	550
ENHRHARDT H	2179 2510 2658 3252 3377 3391 3410 3747 3770	HALL R	3343
EISSNER W	3732	HANNER J H	2123
EITEL H	3811	HANSON H P	2784 2954
ELFORD M T	2433	HARA S	2464
EL-SHERRINI TH H	3819	HARRISON M F A	2788 2790
EMELYANOV A M	3050	HARRIS F E	2754 3686
EYB H	3391	HASHIMOTO	2070
FEAUTRIER N	3348	HASTED J B	3743
FEDOROVA G M	2729	HAUG R	3570
FELDMAN P	2759	HAYAKAWA S	2968
FELS M F	2774	HEDDLE D W O	2642 2648
FELTSAN P V	2725 2795 2833 2909 3000	HENDERSON M R	3841
FERRANTE G	3827	HENGLEIN A	3641
FESEK S	3323	HENRY R J W	588 2616 3260 3349 3780 3843
FINEMAN M A	2784 2954	HERMANN H	2753
FINK H	3773	HERTEL I V	3514 3519 3776 3777 3778
FIQUET-FAYARD F	2969 3023	HERZENBERG A	2004 3340 3806
FITE M L	3841	HETTEL H J	3803
FOGEL Y A M	2174	HILS D	2021
FOURNIER A Y	2872	HOFFMANN C R	3702
FOWLER R G	2923	HOLLAND R F	2785 2976
FRANCO V	3822	HOLT A R	2159
FRASER P A	1169 3053	HOLT H K	1977
FREUND R S	3205	HOOPER J W	2938
FRIDKIN L A	1970	HOUSTON S K	2059 3586
FRIEDMAN S I	2440	HUEBNER H	3742
FRISH S E	2643 2971	HUGHES R H	2690 3846
GARCIA J D	2905 3745 3750	HUSAIN D	1364 3840
GARGA I I	3528	HYMAN H	613
GARRETT M R	2071 2893 3701	INOKUTI M	2655 2783 2837 2945 3415 3521 3847
GAUDIN A	2744 3580 3581 3582	IONIKH YU Z	3807
GAVALLAS L A	2911 2957	ITIKAWA Y	3706 3707
GELTMAN S	1993 2060	JACKSON H T	2071
GERACITANO R	3827	JAGER K	3641
GIBSON J R	3850	JETTE A N	1689
GINGO P J	878	JHA R	1182 2126 2127 2129 2749 2968 3394 3452
GLASER F M	2827	JOACHAIN C J	1941
GLUPE G	589	JOSE J D	2126 2838 2903 3583

JORY R L	2433		LAN V K	2115	3348
JOSHI S K	3709	3735	LASSETTRE E N	2659	2694
JOST K	3811			3547	2696
JUNDI Z	2012		LATYPOV Z Z	3809	2827
KAGAN YU M	2957		LAU H S M	3814	3546
KANG I J	3255		LAWSON J	2075	
KARATVANOV V	3342		LEA K R	3001	
KARSTENSEN F	3512		LEE A R	3338	
KARULE E M	2937		LEE E T P	1942	2626
KEESING R G W	2642	2648	LEVENTHAL H	3001	
KELLY H P	2758	3404	LINDER F	2510	3252
KENNEDY D J	3002	3018	LIN C C	1942	2016
	3019	3341	2626	2769	2923
	3587		LIN S H	3211	
	3733		LIN S S	2944	
KESSLER J	3811		LIPSKY L	2427	
KHAIKIN A S	2698	3457	LLOYD D	3054	
KHARE S P	2024	2866	2627	3749	
KHODEEV YU S	3850		LONG D R	3589	
KHVOSTENKO V I	3416	3417	LONG R L	3027	
KIEFFER L J	2614	2647	LUCAS C B	2916	
KIM Y K	2837	3415	3521	3847	
KINDLMANN P J	613		LUFFMAN S L	3737	
KINGSTON A E	2023	3002	3018	3819	3208
	3507	3587	3733		
KISHKO S M	3387		LYASH A V	1970	3059
KISTENAKER J	2349		3579		
KIVELSON D	3283	3204	MADAI R N	3371	
KLEINPOPPEN H	2021	2902	MALIK F B	1364	
KLEMPERER H	3205		MALINOWSKA-ADAMSKA	2714	
KLYUCHAREV A N	2643	2971	MALYUTA D D	3568	
KOHL F J	2900		MANDL F	2004	
KOLBENSTVEDT H	2901		MANSON S T	3025	
KOLLATH R	2326	2327	MARCHAND P	3035	
KOLODZIEJSKI R	3642		MARMET P	3035	
KOOZEKANANI S H	2076	2974	3249	3456	3525
KOPPE V T	2174		MARRIOTT R	3057	3388
KORCHEVOI YU P	2715		MARTIN S O	3400	
KOROL V I	3387		MARTINS P DE A P	3739	
KOSCHMIEDER H	2021		MARUSIN V D	1988	
KOVAL A G	2174		MASSEY H S W	2075	
KRAIDY H	1169	3053	MATHUR K C	3709	3735
KRAISS E	2982		3837		
KRAUS K	2975		MAZEAU J	3343	
KRAUSS M	2913	3206	3823		
KRIGE G J	3531		MCCARROLL R	1171	
KRUEGER T K	2335	3294	MC CONKEY J W	1214	3246
KUMAZAKI T	1968		3760	3762	3851
KUPPERMANN A	2773	3545	3728	3813	
KUPRIYANOV S E	2660	3768	MCCULLOH K E	3068	
KUYATT C E	2912	3209	MCDONALD F A	3001	
KYLE H L	3861	3526	3775	3839	
LABAHN R H	2959	3772	MCDOWELL N R C	1946	1951
LANE N F	1993	3349	2013	2836	3054
	3843		3522	3775	3839
LANGHANS L	3377	3410	MFARLAND R H	2541	2713
			MCGOWAN J W	2784	2954
			2955	3373	3836
			MEHLHORN W	589	2797
			MEHR J	2290	
			MEISTER H J	3802	
			MELTON C E	2899	
			MENENDEZ M G	1140	1977
			MERCER G N	613	3767
			MICHELS H H	2754	3686
			MIELCZAREK S R	1140	2841
			2912	3209	3823

HILLER K J	2913	3206	3823	PHELPS A V	2078
MIRZA I M	2964	3524	3769	PICHANICK F M J	2962
HITTLEMAN M H	1941	2774		PLATZMAN R L	2837
MIYAMOTO S	3069			PLUTA K M	1946
MJOLSNESS R C	2211			POLUSHKIN I M	2906 2956
MOHLER F L	2215			POVCH M M	2725
MOHR C R O	3738			POWELL R E	1881 2422
MOISEIWITSCH B L	2059	2159	3216	PRASAD S S	1183
MONNIN C F	2786	3803		PRESNYAKOV L	2065 3698
MONTERDE-GARCIA A	2753			PROK G M	2786 3803
MOORE E J	3215			PRZHONSKII A M	2715
MOORES D L	3518			PURCELL E M	2063
MORGAN L A	3704			PU R T	2005 2959
MORRISON D J T	2022	2685		RABIK L L	1970 3058
MOUSTAFA MOUSSA H	2929	2945	3541	RAFIQULLAH A K	1364
MULLER F	2969			RAHMAN M	3840
MUSCHLITZ E E	2175			RAI D K	3804
NESTOR C M	1364			RAKHOVSKII V I	2729
NEUERT H	2730			RAMSAUER C	2326 2327
NEWTON A S	3756			REDHEAD P A	3323
NIEHAUS A	2737			REDKO T P	2967
NIGHAN W L	3202			REES J A	2120 3051
NISHIMURA H	1968	3024		REINHARDT J	3343
NORTON T G	3846			REINHARDT P W	3763
NOVICK R	2759			REMPT R D	3834
NUSSBAUMER H	3732			RICE J K	3545 3813
NUTTALL J	3801			RICHARDS H L	2175
NYGAARD K J	3455			RIDGE D P	3824
NY T	2328			ROBINSON E J	2060 3826
OBEDKOV V D	3684			ROBISCOE R T	3001
OCHKUR V I	2756	3805		ROGALSKI M	2116
OKSYUK YU D	2966			ROSS K J	3514 3519 3776 3777 3778 3809
OMIOVAR K	2067	2077	3061	ROtenberg M	3057 3388
	3746			ROY A C	3705
OOSTERHOFF L J	3810			ROZSNYAI B F	2914
ORMONDE S	1976	1999	2427	RUBIN K	2822 2947 3849
	3056	3742	2791	RUDGE M R H	2022 2685
OTSUKA M	1968			RUDOLPH P S	2899
PALINCHAK Y V	2907			RUNDEL R D	2788 2790
PANCHENKO V E	3693			RUPPEL H M	2211
PAQUET C	3835			RUTHERFORD J A	2308
PAVLOV S I	2729			SAMPSON D M	2826
PEACH G	3585			SARAPH H E	2020 3294 3732 3739
PEART B	2977	3296	3400	SCHACKERT K	3913
PECUL K	2965			SCHEARER L D	3565
PEEK J M	2210	3842		SCHLESSINGER L	3511
PEIXOTO F M A	3744			SCHRÄM B L	2349
PENKIN N P	2967			SCHULZ G J	2078 2763 3389
PERCIVAL I C	1168			SCHULZ M	3747
PERESSE J	1888	2870	3527	SCHUTTEN J	3729
PERLMAN H S	2695			SCHWARTZ R	1889
PETERKOP R K	3683			SCHWARTZ S B	3736
PETRINI D	1138	2832			

SCOLSKY R H	3686		TISONE G C	2904	
SEATON M J	2020	3567 3732 3739	TIWARI P	3804	
SHARP T E	2205	2577 2939 3267	TRAJMAR S	3545 3813	
SHARPTON F A	2128		TRIPATHI A N	3709 3735 3837	
SHEMMING J	2020	3294	TRIPATHI D N	3804	
SHEOREY V B	3567	3844	TRUHLAR D G	3728	
SHEPPARD R J	893		TUFFIN F	2870 3527	
SHEVERA V S	3419		TULLY J C	3411	
SHIMIZU M	2057		TURNER B R	2308	
SHIMON L L	1969	2069 2366	UY O M	2900	
SHPENIK O B	2074	2757 3063 3418	VAINSHTEIN L A	2065 2648 2733 2799 2946	
SIL N C	1178	1182 1904 2114 2126 2127 2129 2751 2968 3394 3452	3060 3865 3698	VALENTINE N A	1168
SIMPSON F R	3762	3851	VAN BLERKOM J	3214	
SIMPSON J A	1140	2841 2912 2962	VAN BRUNT R J	2614	
SINFAILAM A L	3700		VAN DEN BOS J	3730	
SJOGREN H	2119		VAN DER WIEL M J	2349 3819	
SKARSGARD H H	3702		VAN ZYL B	2171 2772	
SKERBELE A	2659	2694 2696 3546 3547 3809 3814	VASAVADA K V	2027	
SKLAREK R C	3516		VELDRE V	1970	
SKUBENICH V V	1989	3064 3374 3387 3578	VINOGRADOV A V	2640 2799 3068 3065	
SLOAN I H	3215		VOLKOV YU M	3568	
SMITH A C H	2790		VON PUTTKAMER E	2658	
SMITH K	1976	2616 3784	VOUGHT R H	2706	
SMITH S J	3027		VRIENS L	1159 2017 2841 3289 3584 3819	
SNODGRASS H B	2177		VROOM D A	3687 3812 3831 3832	
SOMELMAN I	2065		VUKSTICH V S	3528	
SOLTYSIK E A	2072		HALDRON H F	1945	
SRINIVASAN V	2128	3051	WALKER D W	3731	
SRIVASTAVA B N	2964	3524 3769	WALLACE J	2075	
SROKA H	2782	3833	WANG K I	2918	
STAFFORD F E	2944		WANG K L	3643	
STANTON P N	3710		WAREING J B	2721	
STAUFFER A D	2013		WEAVER L D	2690	
STOCKDALE J A	3006	3763	WEINBERG M	3411	
STRAND T G	3248		WEISS H F	3802	
ST JOHN R H	2128	2838 2903 2923 3710	WEN C P	2123	
SULLIVAN E C	3062		WEKLER B	613	
SULTANOV A SH	3416	3417	WHITAKER M	1999 2427 2791 3055 3742	
SUMMERS C	2888		WHITTEKER J H	3748	
SUNSHINE G	2170	2178	WILKINSON D	2075	
TAI H	3774		WILKINS R L	2777	
TAKAHASHI T	3574		WILLIAMS A J	2915	
TAKAYANAGI K	2783	2798 3574 3706 3707	WILLIAMS J F	3373 3836	
TAYLOR A J	2792	3055 3056 3734 3838	WILLMANN K	2179 2650 3747	
TAYLOR H S	2777	3377	WONG D Y	3370	
TEKAAT T	3747		WOOLSEY J H	1214 3246 3760	
TEKIN A	2027	3828	YAI'HONTOVA V E	2620	
TEUBNER P J	3774		YATES A C	3248 3773	
THOMAS B K	3750		YAVORSKY B	3616	
THOMPSON D G	1139		YEATES C M	2823	
TICE R	3203	3204			

ZAPESOCHNYI I P	1969	1989	1990	2069	2074
	2725	2726	2757	2830	2833
	2987	2909	3000	3063	3064
	3416	3419	3526	3590	3699
ZARE R N	2691				
ZHUKOV I G	3528				
ZIESEL J P	2760	2761	2762	2969	
ZINOVIEV O A	3568				